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AUTHOR Soete, George J.
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ABSTRACT

Geographic Information Systems (GIS) integrate computer hardware, software, data, and the human mind to bring new perspectives to creative problem solving. The power of GIS is in adding a graphic, spatial dimension to problem solving. Still an emerging technology for most libraries, GIS can be expensive, entails a steep learning curve, and consumes large quantities of computer space. However, strong partisans claim it has already revolutionized the way people look at the world and will solve the world's problems. Most libraries are considering not whether they will offer GIS-based services, but how they will offer them. This report discusses some of the critical choices library planners must make: (1) what kind of service to provide; (2) how to build the collections; (3) staffing the GIS services; (4) learning and educating others about GIS; (5) how and with whom to form partnerships; (6) how and where to store data; and (7) how much it will cost. Based on interviews with 26 information professionals, "Reports from the Field" are presented on GIS-based services at 20 academic and public libraries across the United States. Contact names and information are provided for almost all of the libraries discussed. Future trends in GIS services are identified. (SWC)

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written by
George J. Soete,
Transforming Libraries Editor

Editorial Advisor
Prudence S. Adler,
Assistant Executive Director
Association of Research Libraries

Systems and Procedures Exchange Center
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OMS Program Officer for Information Services

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ASSOCIATION OF RESEARCH LIBRARIES
OFFICE OF MANAGEMENT SERVICES
21 Dupont Circle
Washington, DC 20036
Phone (202) 296-8656
Fax (202) 872-0884
<URL:http://arl.cni.org> <pubs@cni.org>

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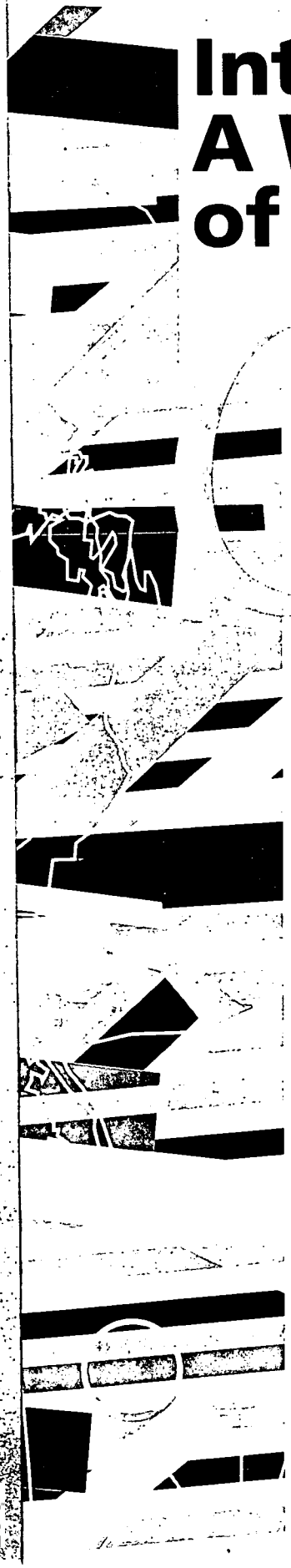
Introduction: A Whole New Way of Thinking



GEOGRAPHIC Information Systems (GIS) represent, for many, an entirely new way of looking at information. Such systems integrate computer hardware, software, data, and the human mind to bring new perspectives to creative problem solving. To solve problems using GIS, you must have "geo-referenced" or spatial data that can be layered with other data. To invoke an example from one of the reports that follows: if you have, for the same urban region, the locations of public health clinics, city bus lines, and concentrations of below poverty line residents, GIS will help you draw inferences about the availability of public health care in the region by combining and layering the data on a map. You might use the resulting information to petition the city to open more clinics or to support your request that the bus routing be changed. The power of GIS is in adding a graphic, spatial dimension to problem solving. On the simplest level, it can make an undergraduate's term paper more persuasive. On a larger scale, it has been used to make key decisions in environmental planning, as well as in designing multi-million dollar national marketing campaigns.

Though GIS has been around for a while, it was not until the 1990s that it became a "popular" technology. Until then, it was largely the province of professional geographers, who used GIS in their research and instruction or in their work as commercial analysts and mapmakers. Two events changed that for libraries. First was the decision of the U.S. Government Printing Office to distribute most data in machine readable form; with the distribution of 1990 census data on CD-ROM, libraries were forced to consider computerized ways of dealing with digital data. The second was the emergence of relatively inexpensive GIS software; this development led to the programs such as the ARL GIS Literacy Project, which, through a partnership with ESRI and other public and private partners, introduced GIS technology into many ARL libraries.

Still an emerging technology for most libraries, GIS raises a host of issues. It can be expensive, it entails a very steep learning curve,

and it eats computer space. At the same time, it is an enormously attractive technology that its strongest partisans claim has already revolutionized the way we look at the world and the way we will solve the world's problems. Somewhere among all the pros and cons is an unavoidable fact: GIS is here to stay, and it is likely to become as firm a fixture in twenty-first century libraries as automated catalogs and multimedia collections are today. It is already entering the curricula of many K–12 programs and is fairly well established as a subject of study at the college level. The question for most libraries is not whether they will offer GIS-based services, but how they will offer them.

One theme emerged clearly in conversations with the 25 or so information professionals who contributed to this issue: GIS is but a hook on which to hang a very large garment. GIS itself is nothing (except to the GIS software technician, perhaps) without the data that bring it to life. Insufficient or inaccurate data inevitably make for poor quality information, despite the most sophisticated GIS. Effective use of GIS also depends on effective problem-solving skills. Both users and librarians now need to know about data, data provenance, and data quality. We have to ask the right questions—both users, as they conduct their inquiry, and library staff, as they conduct reference interviews and coach users in their searches. Finally, GIS requires "spatial literacy," a term that you are likely to hear more and more in coming years; this does not mean full acquaintance with the science of geography, but it does mean an ability to interpret problems and their solutions in spatial terms. Since data has, for most of us, usually been presented in tabular form, spatial thinking takes a bit of time to master. Says one librarian, "We have a new educational role—to teach our users about data!"

Though they are using GIS, libraries rarely focus on the technology itself. Sometimes there is a brief infatuation with the technology, but soon a realization sets in: though the technology is new, traditional skills of librarianship are required to use it effectively. User needs must be evaluated; data must be selected, cataloged and prepared for users; public services must be designed, offered, and managed.

In fact, if there is anything significantly new about GIS-based services for libraries, it is the clear realization that you cannot do it alone. More than any other service, GIS requires teamwork in the library and partnerships with outside entities. GIS is simply too complex and too expensive to manage on your own. Everyone interviewed for this issue has been active in seeking and getting outside help—to get data, training, systems support, etc. As one librarian put it, "I have never had to be as entrepreneurial as I have had to be with this!"

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Critical Choices: Key Questions for Planners

IN DESIGNING or rethinking GIS-based services, library planners have a number of questions to answer and choices to make:

What Kind of Service Should We Provide?

The GIS installations described in this issue range from a single machine with limited GIS functionality available in the public services area to multi-million dollar operations. Most libraries have had to draw the line on the kinds of GIS services they offer; there are several ways to do this. One is to make user access as self-service as possible by designing point-and-click interfaces or by providing access over the Web. Most have policies, either written or unwritten, asserting the level of assistance that will be provided. Virtually no one will do all the work for the user, and most interviewees had learned that service could overwhelm you if not managed carefully.

Several libraries currently provide mediated service by appointment to get the user started; a few provide service only in this way. Many academic libraries have student assistants who provide mediation and instruction in a lab setting; if they are lucky, these students will already have received training in GIS in local courses. One interviewee stressed that service must be promoted at first—it is a mistake simply to set up a machine, put a sign over it, and hope for the best.

Libraries should develop GIS-based services much as they would other services. An important first step is to analyze user needs and capabilities. If the need is primarily at the undergraduate level, a relatively simple ArcView installation might be sufficient. If users are going to need direct access to data and powerful data manipulation capabilities, more sophisticated installations will be needed.

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Locating GIS services is not necessarily a straightforward issue. Though they are often placed in a map department, they are just as often found in general reference or documents units. One maps librarian, in fact, suggested that they may not be well-placed in a one- or two-person map department, as the demand for GIS service could easily take up all the staff's time.

How Will Collections Be Built?

Though you can purchase books and journals related to GIS, "collections" typically means data. If you are a government documents depository, chances are you already have a great deal of data on CD-ROM. If not, such data are relatively easy to acquire either directly from the government or through companies like ESRI and Wessex, which produces the TIGER/Line files. Other commercial companies provide data as well. Some GIS software packages have built-in datasets, but these are likely to be of limited use for many library users (they can be used, for example, to learn more about the GIS system). You need to be sure that acquired data is "geo-referenced"—that it can be related to points, lines, or areas on the earth's surface so that it can be used in combination with other data.

The most challenging collection task facing libraries is to acquire local and regional data as cheaply as possible. The need for local data is perhaps obvious: the general public will have more locally-oriented queries than other kinds and, even in university settings, problems chosen by students and researchers will often have a local focus. However, datasets of any sort are usually expensive to produce so convincing data creators to part with them for free or even at cost can challenge even the most persuasive librarian. The message from successful librarians in the field is simple: network, network, network. Attend GIS user group meetings, both on campus and off; start talking with data producers, especially in government agencies. Many librarians have succeeded by making the case that agencies will be able to refer users to the library instead of taking on the burden of trying to answer their queries. Others have offered to barter data if they have it. One source of data in an academic setting is the campus itself; often data are available from the Physical Plant Department, the Registrar, and other campus agencies.

As with any other collection development task, having a policy in hand is a big help. There is a great deal of data available, and you must make choices. Your policy should indicate what kinds of data you will focus on (especially the local and regional boundaries that you buy within); what formats you will acquire (a consideration

here is what formats your users are familiar with and use regularly); what map scales you will prefer; how you will deal with copyright and licensing restrictions, if applicable; and to what extent you will purchase data and/or depend on gifts, barter arrangements. As an example, raw data acquired as gifts often must be reformatted and/or cleaned up. Do you have the capability in-house or on campus to have this done?

Who Will Staff the GIS-Based Services?

Virtually no one who was interviewed suggested that you could get very far with GIS without some resident technical expertise. Often it was suggested that you will need at least a full-time person focusing on GIS from a technical point of view if you are to mount an effective service, try to keep up with technical developments, and pilot innovative approaches to GIS. One factor reflects the "use it or lose it" syndrome: if you do not regularly work with GIS, you can quickly lose the skills you've acquired.

Several libraries, therefore, have hired or are recruiting a librarian or a high level technician. Often such a person will be a data technician or data services librarian who does GIS work as part of the job. Student employees can be a boon, especially if they have been trained in GIS by the campus geography department. One innovation features a "co-op" program in which geography students actually receive credit for working in the library's GIS lab.

As a result of this need for resident technical expertise, virtually all the librarians who manage GIS-based services said they were moving away from being—or had never become—GIS experts. They saw their roles as collection developers, data acquirers, service managers, resource petitioners, and partnership developers. In some cases, when they did not have the appropriate skills on staff, they used local GIS consultants to design specific products or outsourced data conversion to other campus agencies.

How Will We Learn—and Educate Others—about GIS?

Almost everyone agrees that GIS involves a steep learning curve. Even seasoned map librarians, as one of them confided, often have to relearn their subject when faced with GIS. As planners, you need to build training and staff development into your GIS program. One librarian suggests building in a comfortable period

for you and your staff to learn about GIS before beginning to offer services.

Fortunately, there are more resources today than ever before. GIS is well-covered in the literature. But more effective might be to start with a very simple off-the-shelf product, such as the Rand-McNally Street Finder or ArcView's BusinessMAP. The latter has built-in data and a very simple set of exercises at the front end. Beyond this, there are probably courses offered at the community college or college level on GIS in your area; there might be one-day workshops as well. User group meetings are cited by all interviewees as critically important to both the learning and the partnering processes. There are numerous tutorials available on the Web as well.

Eventually, more and more users will know GIS basics when they come to the library. It is being taught in K–12 curricula and is even beginning to come packaged, in rudimentary forms, with standard software such as Microsoft Word. In the meantime, libraries are offering one-on-one assistance, and some have developed GIS orientations. One strategy for coping with diverse skill levels is to customize ("strip") functionality in GIS software to make it easier to use.

Several librarians point out a more profound issue: teaching users, and ourselves, about data. The technically proficient GIS user who does not know how to use data effectively or responsibly can be as significant a problem as the GIS-ignorant user. If anything, content is the current frontier in GIS education.

With Whom Will You Collaborate?

As suggested above, GIS-based services must be developed in partnerships, both inside and outside the library. Librarians interviewed for this issue have partnered with a great variety of agencies and individuals. The most obvious initial need is to work with others in the library and on campus. If you are the map librarian, you need to work closely with documents, data services, subject bibliographers, and other staff. Developing a close alliance with your own systems department—or your computing center—will be critical. Some services may be best outsourced to other campus departments—data laboratories, for example. Working with interested researchers and other users of GIS is essential.

Outside your institution, you will want to develop mutually beneficial relations with government agencies at the local, regional and state level. The best means of starting such partnerships

appears to be attendance at GIS events, such as user group meetings and workshops. Another resource is vendors; they may be interested in helping you set up an installation by providing free or discounted software or data. Consortial partnerships, according to one librarian, are yet to be fully exploited. Sometimes, government agencies will appreciate being approached by a consortium rather than numerous separate libraries. Consortia can also provide shared training, data, etc.

One of the real advantages of the library in a GIS partnership is its neutrality. University researchers will easily see the library as a natural place to deposit data that they might be reluctant to share directly with colleagues. Several interviewed librarians commented on the power of the library's neutrality, one offering, "People want to give us their data as soon as they understand our role and our value to them."

How and Where Will We Store Data?

Data storage has been a big issue in GIS installations, and libraries have solved the problem in a variety of ways. GIS, according to one librarian, is a "memory hog." Another simply said, "It is our duty to find storage if we don't have enough." If the library or the GIS-based service has its own server, data storage is usually not a tremendous problem. Some sites are using Zip or Jaz drives and disks to store large datasets temporarily. Occasionally, storage space must be requested from a central computing facility, but convincing them that you really need it can be a challenge.

Several librarians noted that data storage problems will eventually disappear as systems become more and more powerful. Virtually all, however, warned developers of new GIS-based services to "buy big"—at least double or triple what you think you will need. Many sites are saddled with upgraded 486 machines that are simply inadequate.

What Will It Cost?

GIS represents a significant investment in hardware, software, staffing, data acquisition, and ongoing staff development. Either new money or significant reallocation is required. For this reason, many librarians advocate starting small and focused, with one or two powerful machines that will impress both users and the administration with the wonders of GIS. This is best accomplished

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through demonstrations or real problem solving at the local, recognizable level. Finding a map of someone's street, or showing locations of shopping malls in their zip code areas can be quite powerful. Even visiting the VISA Website and finding maps indicating the location of automated teller machines near your home can demonstrate the power of GIS.

Costs can be managed through strategies such as campus site licenses for GIS software that lower the overall price tag. Distributed storage of data (e.g., within a consortium) and tightly focused collection development are two other options for keeping costs down.

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Innovations: Reports from the Field

TWENTY-SIX information professionals were interviewed, mostly during January 1997, for the reports that follow. The first report is a first-hand account written by Melissa Lamont of the Penn State University Libraries; it is a slightly updated version of an article she wrote for an issue of *ARL: A Bimonthly Newsletter of Research Library Issues and Actions.*

Case Report

Using Partnerships to Develop a New GIS Service at Penn State

By Melissa Lamont, Maps Librarian

Just about everyone who has written about geographical information systems (GIS) agrees that they pose daunting service and collection challenges for libraries. Such systems can be expensive and can require skills not yet adequately developed in library staff. And yet the allure of GIS is strong. The most compelling and exciting attraction is inherent in GIS itself: the ability to depict information in new and vivid spatial terms. GIS enables the layering of two or more sets of data that refer to the same geographical area, often leading researchers to discover new relationships and insights—in essence, new information. Thus environmental scientists might map the locations of a region's mineral deposits, while economists might map the amount of ore retrieved during a certain period in the same area. Layering these two datasets may help us discover new ways to approach land management in the region. GIS technology is being used by criminal justice specialists to understand patterns of crime in neighborhoods and by epidemiologists to track the spread of disease throughout the country, as well as by a host of other researchers in virtually all disciplines.

A small wave of library literature has recently focused on GIS, extolling the value of incorporating GIS services into the library.

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At the same time, we have been warned of several challenging issues. GIS represents a steep learning curve for most library staff; it is simply different from the bibliographic databases that we have been familiar with. It requires a substantial investment in hardware, software, and human expertise. Understanding these challenges, the Penn State University Libraries began to plan for GIS services in early 1995.

A scan of the local environment suggested the library was in an excellent position to develop such a service. The libraries function as the Regional Map Depository for the state, house a large map and atlas collection supporting a strong geography department, and have participated in ARL's Geographic Information Systems Literacy Project since its inception. Anecdotal evidence suggested that the demand for electronic mapping services existed, especially among non-traditional users such as historians, anthropologists, and health care professionals. Since more traditional users—for example, geographers and agronomists—usually want data rather than analytical capabilities, providing a data-location service for them would also be considered a worthy goal. Such a service would be strongly valued in a climate in which data is often difficult to find, especially given the tendency of data producers to charge for access as a means of recouping costs. A further environmental factor was the lack of coordinating agencies for GIS data and services in either the university or the state. Finally, GIS was seen as one means of meeting an important goal of the university's new President: community outreach.

This brief analysis revealed a lack of appropriate coordination of the production, documentation, and archiving of GIS data. Also lacking were GIS facilities for casual users. In response, a new mission had to be drafted for GIS services: to create a digital library of spatially referenced data; to make the data available to the widest number of users through in-house facilities and the Internet; and to acquire, organize and archive these data, particularly data concerning Pennsylvania. Fulfilling the mission would require sophisticated computer equipment; new software; a cadre of technical and support personnel; a great deal of planning; and a commitment to significant evolutionary change.

Given the size and cost of the task, it soon became apparent that the GIS initiative would require forging new partnerships and building on existing relationships outside of the libraries. Thus, together with Penn State's Department of Geography and the Center for Academic Computing (CAC), the libraries developed a plan to place a fully functioning GIS Center within the maps room. Each partner contributed time and resources to the project, and representatives met regularly to move the project forward. The CAC provided most of the hardware and technical support. The Department of

Geography developed a three credit course to offer students an internship in the GIS facility. The libraries contributed hardware, space, furniture, and coordination.

The libraries reconfigured the maps room, freeing space for eight personal computers connected to a UNIX server, along with the necessary furniture, wiring, and cabling. ArcView and ArcInfo software, already licensed and in use as part of the ARL project, were chosen. In January 1996, after nearly a year of planning, CAC installed the hardware and the GIS Center was ready for users.

Also in January, the geography department offered the first GIS Intern Course, one of the truly innovative outcomes of this partnership. Thirteen undergraduates were selected to participate in the course, developed by a geography professor and a graduate student. The participants, all of whom had excelled in the introductory GIS course offered in the geography department, represented many different majors—mathematics, engineering, sociology, English, as well as geography. The GIS Intern Course had two major objectives: 1) to provide the library with trained staff to assist in the operation of the GIS Center, and 2) to provide students with practical, real-world experience with GIS and to develop communication skills needed to interact with clients of varying skill levels. The first third of the course included an introduction to the organization and services of the libraries; sessions on ArcView and other mapping programs; and basic instruction in Webpage creation. During the final two-thirds of the course, students staffed the GIS Center for most of its hours of operation.

Developing a service policy for the GIS Center became an important first priority. Planners agreed that the center should not be a production facility; researchers, not center staff, would be responsible for intellectual processes such as data manipulation and display of data on maps. Instead of creating maps for users, the intern's job was to offer instruction in software use and guidance in finding appropriate datasets. As an aid to the interns, a simple service policy statement was developed that clearly delineates these boundaries. In addition, referral information for laboratories and firms that offer analytical services, as well as information on several commercial cartographic consulting firms in the area and a list of books and courses, is available for users who want more information.

As a course requirement, each intern had to develop a project that would enhance the operations of the GIS Center. The interns quickly intuited the needs of the facility, developing creative and useful projects. One constructed a GIS Center handbook, complete with policies, procedures, and basic operational details. Another developed a Web interface for the Digital Chart of the World dataset. Still another created a cookbook featuring a sample map, a recipe

showing the software and data needed to create a similar map, and instructions on how to operate the software.

The success of the internship course was demonstrated in the libraries' decision to hire two of the interns to work during the summer and the Geography Department's plans to continue offering the course; thus providing the library with an ongoing pool of trained and experienced personnel who will continue developing projects and skills essential to the success of the center.

At the same time, the GIS Center staff looked toward their role as data providers. Again, the challenges were many, but they were met through partnerships. Data acquisition is often a matter of feast or famine. Most libraries use a fraction of the flood of electronic information that pours in through the Federal Depository Library Program. At the same time, obtaining state and local data can be an ongoing challenge: many smaller governments want to charge for data and few are organized to provide information efficiently to the general public. The libraries were thus positioned, with a service space and staff, to pursue another goal—to offer government agencies an outlet for their data and a point of contact for the general public.

The libraries entered another partnership, with the Environmental Resources Research Institute (ERRI), a semi-independent research group with GIS expertise, and the Deasy Geographics Laboratory, the campus cartography lab. The goal of the partnership is to distribute Pennsylvania-based spatial data. The group is working under contract for the Pennsylvania Department of Environmental Protection (DEP) to develop a Commonwealth GIS data management and distribution system that will search, retrieve, report and distribute spatial data maintained by DEP, Penn State, the federal government, or any other appropriate group. The project is tentatively named the PA Spatial Data Access (PASDA) system. ERRI staff coordinate the project and handle the budget; Deasy staff are working on Web designs; the libraries document the data and provide public service. Readers can access the PASDA prototype at <http://www.pasda.psu.edu> and the Maproom site, which now includes the DEP and federal data, at <http://www.maproom.psu.edu>. On the PASDA Website, users can now perform keyword searches on the metadata, after which they can access either the data or a ".gif" image.

In addition to PASDA, the Maps Collections staff is also working on an online interface for commonly requested geo-referenced information on Pennsylvania, followed by an international template that will work in a similar fashion. Soon users will be able to move from county level data (e.g., county business patterns) to information by zip code. Another project in development is the Electronic Atlas of Pennsylvania, for which an interactive capability is planned.

These partnerships have provided the GIS Center with a trained, continuing student staff and the Geography Department with a practical, hands-on GIS course. The Center for Academic Computing provides help with hardware issues, and they are testing new file storage and transfer systems. With ERRI and Deasy the libraries have developed PASDA as a Web interface to distribute spatial information to students and researchers, the state, even the nation. DEP now has an outlet for their data and a public service contact point outside their own offices; other state government agencies will be welcome to follow DEP's example by contributing data to the PASDA.

Partnerships are not new or unique. That so many creative people from so many agencies were brought together to develop the Penn State Libraries' GIS Center, however, appears to be unusual. The success of the project, for the libraries, is directly attributable to the success of these partnerships.

GIS-based services at nine ARL libraries

MAGIC: UConn Provides Sophisticated GIS Services on a Shoestring

Ten years ago, Patrick McGlamery, University of Connecticut Map Librarian, and a graduate student wrote a program that would generate maps from 1980 census data. From that pioneering effort has grown UConn's Map and Geographic Information Center, MAGIC. What is remarkable is how innovative MAGIC has been, given the fact that it is basically a one-person operation and has limited itself to the sort of affordable low-end hardware (approximately $15,000 spent to date) and software that is within the reach of most libraries. In spite of its modest staff and resources, MAGIC has developed partnerships on campus, as well as with many state agencies in Connecticut. Many of these agencies see MAGIC as a convenient way for them to get their data to the state's citizens.

MAGIC is "a library of digital geo-spatial data." All MAGIC data that is available through FTP are in the public domain, and all data are currently accessible on the MAGIC Website. Licensed data are available only on the Storrs campus.

The major focus of MAGIC data is Connecticut, but other data are available on the system as well. Interchange formats enable Mac, UNIX or DOS users to access data if they have ArcInfo or MapInfo. All of these choices were deliberately made to maximize the utility of MAGIC for as many users as possible. And the choices have paid off in terms of use; in November 1996, more than 4000 data files were downloaded by users.

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Another choice has governed MAGIC's evolution: the decision to focus on building data collections rather than to focus on GIS or mapmaking services. Building data collections entails an enormous amount of refining for the users, a process that McGlamery likens to the traditional collection development that librarians have always practiced. Thus a great deal of time is spent selecting from CD-ROM products data that relate to Connecticut and translating the data into formats that are readable by the majority of users. Often, this process involves "rebinding" county level data into town level units, a product that serves the town-oriented citizens of New England much better. All data are in the public domain.

Though GIS is an important part of the technical infrastructure of MAGIC and though McGlamery keeps up with the technology, little of his day-to-day work concerns GIS. McGlamery is getting more into contracting and partnering with data providers and his level of activity is moving downward in an organized manner, while students handle most of the technology. Now that the federal government has made most of their data available and the State of Connecticut is well on its way to solid coverage, the next level to work with will be regional planning councils, then towns. A key challenge will be persuading planning council and town officials to share data by showing them how it benefits them; such benefits will include better service to constituents who request data.

Current projects continue the tradition of innovation. MAGIC is mounting data associated with the book *Connecticut Town Profiles*—this will be an invaluable resource for both in-state and out-of-state users. Well worth a look on the MAGIC Website is the town page, which has been designed to shortcut laborious hierarchical processes: one can, through a reference interview process, move easily from town to town. And there are intriguing projects in the planning stages. One is to build into MAGIC the capability of pointing to data resident on "native" machines. That is, one would be able to move directly from MAGIC to access Connecticut data at the Department of Transportation or the National Wetlands Project.

Contact: Patrick McGlamery
Phone: (860) 486-4589
Email: <libmap1@uconnvm.uconn.edu>
Website: <http://magic.lib.uconn.edu>

Harvard College Library Makes the Massachusetts Electronic Atlas Available

There has never been a current state atlas for Massachusetts. Thus the Harvard College Library's Map Collection is particularly proud

that they have just mounted the Massachusetts Electronic Atlas on the Web.

The Massachusetts Electronic Atlas breaks new ground in other ways as well: it is a test site for the new ArcView Internet Explorer software of ESRI, providing true interactive mapmaking on the Web. While other locations present static images, the atlas enables remote users to choose a geographic area within the state; select layers of data for display; turn layers on and off; zoom or pan the map; and download the maps and associated numeric datasets.

On another front, Harvard has moved beyond merely stripping state and regional data from federal sources. They have developed many partnerships with state and local agencies and they find that much data gathered from these agencies is geo-referenced. The cooperation of such agencies is particularly critical with the aging of data in the 1990 census. Now Harvard is able to provide up-to-date data on such factors as tax rates, births, SAT scores, and environmental information; citizens around the state are using the atlas to predict school enrollments, analyze language distribution, as well as a host of other purposes.

There is another important reason for moving beyond federal data: often such data works well on the county level but not on the town level, and towns are the key political entities in the New England states. Thus critical partnerships have been developed with planning groups such as the Massachusetts Area Planning Council, which covers the Boston metropolitan area, and the Massachusetts Association of Regional Planning Agencies, MARPA. Such planning groups provide the most convenient conduit to town-level information.

Contact: David Cobb
Phone: (617) 495-2417
Email: <cobb@fas.harvard.edu>
Website: <http://icg.harvard.edu/~maps >

Cornell Makes New York State Data Available on the Net

Joining the growing ranks of ARL libraries making geo-referenced data for their states available on the Web is the Mann Library at Cornell University. TIGER/Line files for New York State can be accessed in the ArcInfo transfer format.

Six different coverages are provided for each county in the state:

- Census places—these are population centers smaller than SDMAs but larger than towns.
- Minor Civil Divisions (MCDs): towns, villages, etc.

- Census tracts—these population-based areas contain 4 to 10,000 people each.
- Census block groups—also population based, these subdivisions of the census tracts typically contain 700 to 1000 people.
- Hydrology groups: streams, rivers, lakes, etc.
- Streets—this level, understandably, is used more than any other.

Such coverage enables quite sophisticated problem solving. One student was able to analyze the adequacy of health care for women below the poverty level in Ithaca, New York (Cornell's "home town") by layering income level, health care facility locations, and bus routes derived from the census block group and streets data.

Cornell is justifiably proud of the availability of hardware and software related to GIS in the Mann Library. In addition to a single GIS workstation and a free color printer in the reference area, there are 26 machines in the computer lab that have commonly used GIS software such as the Wessex loading software, ArcView 3.0, and Geosite Factfinder. The lab is also equipped with a Hewlett-Packard color plotter to print out large maps (there is a charge for this printing).

Since a GIS capability is available in the Mann Library Reference Department, all reference desk service personnel have to have some knowledge of GIS, if only to make intelligent referrals. Philip Herold, who is the department's GIS expert, has therefore provided a two-hour orientation workshop for everyone who offers desk service, as well as for other key service personnel in the library, to equip them with GIS basics.

One recent development really jump-started interest in GIS at Cornell: the acquisition of a site license for ESRI products (e.g., ArcInfo). The use of GIS across campus has increased significantly due to reduced individual user costs and its accessibility to everyone on the Cornell intranet. This development, according to Herold, may lead to his orienting staff outside the library.

Like several other GIS-based services, Cornell's has formed important partnerships on campus. A major partner is CISER, the Cornell Institute for Social and Economic Research, a data archive that does data conversion into the ArcInfo export format so that it can be used in library applications.

Contact: Philip Herold
Phone: (607) 255-7959
Email: <ph31@cornell.edu>
Website: <http://www.mannlib.cornell.edu>
Choose "Gateway."

University of Virginia Shares Its Data on the Web

Although the University of Virginia Library's Geographic Information Center does not serve a campus geography department, it has nonetheless developed extensive and pioneering GIS-based services. The library's most recent project has been to make available a comprehensive database of macrodata for 49 states (Alaska is not included) through FTP as well as on the Web. Users of the system will be able to manipulate as many as 20 layers of information in a search. Librarian Denise Stephens calls this "a big step, a significant gamble" since the library has no idea how much stress new traffic, potentially from all over the world, will place on their system. She is not aware of another library that has made national data of this sort available.

In designing the Web interface for accessing the data, the center identified the intended primary user group by monitoring feedback from users of the Virginia TIGER/Line data that has been mounted on their system for two years. What they found was that professional users—those who are skilled in data analysis and/or GIS technology—are primarily interested in the data, which they put into their own systems for further manipulation. Most people, however, want some sort of visualization—a map of the data—and the system has been designed to accommodate their needs easily and quickly.

Stephens identifies a key issue that the library has struggled with: the migration of data access to self-service modes raises issues of data verification. When she can, she reminds people that the data the library provides is "not to be taken to court." Users need to learn to evaluate data, and the library has a role in educating them—an especially serious role given the tendency of many users to view library personnel as experts. Moreover, Web access cancels out mediation; the library surrenders the concept of addressing individual needs and skills. Whatever mediation the library provides must be designed into the interfaces it creates—not an easy task.

The library depends on an online email feature to get feedback from remote users. They try to be responsive to feedback, some of which can be very forthright and critical. In conceptual development is an online feedback form. However, they find that the most useful feedback they get is simply who is using the system (by domain address analysis) and how they are using it. One hope ventured by Stephens is that they will see a lopsided distribution of

".edu" rather than ".com" or other domains as an indication that they are reaching a largely scholarly audience.

Contact: Denise Stephens
Phone: (804) 924-6259
Email: <cds2m@virginia.edu>
Website: <http://ptolemy.gis.virginia.edu/gicdoc/dlg/dlg.html>

Careful Planning Maximizes Service Effectiveness at the University of Georgia

A needs survey conducted in 1994 was critical in shaping GIS-based services in the University of Georgia's Map Library. This comprehensive survey (available on the *Transforming Libraries* Website) identified current and future campus instructional and research activity related to GIS, as well as perceived needs for help in configuring GIS software, selecting appropriate GIS software, and a host of other potential services. The survey, issued by a campuswide committee, was commissioned by the university's Vice-President for Academic Affairs and had broad campus support.

With survey results in hand (as well as windfall money from the Georgia State Lottery), the Map Library was able to design focused and responsive services. They added to their growing collection of data on CD-ROM (the collection now numbers 800 items). An important acquisition was the library's own file server for storage of GIS-related data. Next, they set aside one public workstation in the Map Library, which has been designed to be as simple to use as possible by mounting applications such as Automap, the Georgia Atlas, MapExpert, and Photopaint. This is the machine that untutored users are directed to, and the staff work constantly to enhance its user-friendly features.

For more sophisticated work, the Map Library maintains a small lab with four workstations geared to graduate level work. These contain GIS application tools such as ArcView, as well as access to datasets. Even here, staff are working constantly to simplify interfaces and promote the self-sufficiency of users.

One trend noted by John Sutherland, Map Librarian, is the quick-and-cheap creation of CD-ROMs containing geo-referenced data. Individual faculty create such discs—chiefly small, contained datasets—as well as governmental agencies. One such agency is the Planning Commission for Clark County, Georgia (the university's location), which has created its own data disc to respond to frequently asked questions.

Contact: John Sutherland
Phone: (706) 542-0759
Email: <jsutherl@uga.cc.uga.edu>
Website: <http://www.libs.uga.edu/maproom/ahtml/mchpi1.html>

Achievements at the University of Minnesota

The University of Minnesota's Map Library is one of the most heavily used in the country, serving a huge number of undergraduate courses in geography and allied fields. This heavy use, their status as a regional GPO depository library, their success in previous II-D grant applications, and the eminence of their Geography Program were important factors in their getting one of the last Title II-D grants from the U.S. Department of Education.

The grant funded equipment and staff to establish a library facility which serves as a gateway for GIS on the campus. A lab with ten workstations was set up and equipped with appropriate printers and a recordable CD-ROM drive, all of which are networked on the Borchert Map Library's LAN and connected to the Internet through the campus Ethernet backbone. Also funded were a network administrator and two graduate students. At the end of the grant, network maintenance was contracted to the campus, but the student employees were continued with library funds. The use of skilled students is described by Librarian Brent Allison as a win-win situation—the library gets the benefit of their training and the students get the real-life experience of working with GIS and interpreting it to users.

Minnesota handles orientation of users by providing weekly sessions that cover basic programs such as ArcView, MapInfo, AtlasGIS, and ERDAS. Though there is someone on-site at all times who can help GIS users, help is limited to coaching: they do not make maps for users.

Minnesota may have the distinction of introducing the first professional master's degree program in GIS technology in the fall of 1997. This is meant to be a terminal degree. Though the program will be administered by the Geography Department, courses will be taught by faculty from all over the campus, including Allison.

Another development to watch for will occupy Allison during a spring quarter research leave. He will develop the Minnesota Demographic Atlas, which will be available on the Web as early as July 1997.

Contact: Brent Allison
Phone: (612) 624-0306
Email: <b-alli@tc.umn.edu>
Website: <http://www-map.lib.umn.edu>

University of Washington Parlays Partnerships into Service Excellence

Without a GIS expert on staff to start their program, the University of Washington Library has nonetheless built a strong GIS program. And though the ARL GIS Literacy Project gave them a push in 1992, a major factor in their success, according to University Librarian Betty Bengtson, has been the effectiveness on the part of key librarians in developing partnerships.

An important first step was affiliation with the campus ArcInfo Users Group, which has since become the UW Consortium for Geographic Information and Analysis. Whatever the name, it is important to find such groups and become involved in their activities, say librarians Eleanor Chase and Kathryn Womble. This was done so successfully that the library has become the "GIS hangout" for the campus—the place to connect with others who are interested in GIS.

The neutrality of the library is a real strength here. When the library plays its traditional role of collecting, managing, and making data and information available for all on campus, no one department "owns" the process, and sharing across campus boundaries, sometimes hindered by politics, is facilitated.

Entrepreneurship in developing partnerships has also paid off in the process of acquiring data. A strong connection with the City of Seattle, for example, has netted 22 gigabytes of data. This relationship and others like it with regional agencies were developed through attendance at users group meetings and similar activities. One challenge, the librarians note, is to keep such collected regional data up-to-date, a process that requires continual maintenance of agreements and cultivation of relationships.

Users of GIS-based services in the library range from high-end users, who simply want to access the data, to the person who just wants a map from the system but does not want to be taught their GIS system, ArcView. This latter group is usually served by student employees. One strategy for meeting the needs of users is to diversify the GIS software that they make available.

The library is considering hiring a GIS staff member. In this regard, Washington resembles other GIS installations that have either hired such expertise or expect to.

Contact: Eleanor Chase
Phone: (206) 543-4664
Email: <echase@u.washington.edu>
Contact: Kathryn Womble
Phone: (206) 543-9392
Email: <kwomble@u.washington.edu>

UC Berkeley Takes a Campus-Wide Task Force Approach to GIS Planning

When the UC Berkeley Library began to plan for GIS-based services three years ago, they faced a significant challenge. Though clearly several campus units were using GIS, there was no organized campus effort, no single place where one could gain a comprehensive sense of who on campus was using GIS or who had geo-referenced data. Moreover, there was little organized sharing of expertise and planning. The library took the lead in establishing the UCB GIS Coordinating Task Force, which could be a model for many institutions as they consider how to organize a campus effort.

Though many universities have GIS user and interest groups and other rather loosely affiliated mechanisms for collaboration among GIS users, the UCB GIS Coordinating Task Force has a formal charge that can be found on the Website provided below. Among its tasks are to:

- initiate formal collaboration of GIS campus-wide activity;
- clarify campus guidelines for data quality and standards;
- investigate data access and delivery, including electronic licensing issues;
- develop a mechanism for faculty to submit metadata to the library;
- develop a mechanism for updating and maintaining data;
- develop a directory of UCB GIS research and researchers;
- clarify the library's responsibilities for integrating commercial, Internet, and lab-owned data in the collection; and
- recommend appropriate services, support, and equipment for GIS in the library.

The task force has several distinctive qualities. First, it is truly democratic; the 27 or so members who are at least intermittently active represent faculty, librarians, campus administrators, and university and library staff. Anyone can attend meetings.

Second, the group deals with both visionary and practical issues. On the practical side, members focus, for example, on recommending the acquisition of site licenses for particular GIS-related products such as software and commercial datasets, and on assessing instructional and research needs for GIS. On the visionary side, the group has played a major role in planning for Berkeley's future involvement in GIS. As the GIS technology has come under more control, focus has shifted to broader concepts such as "geographic information science" and to broader issues such as data storage and distribution, as well as the entire campus

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infrastructure for electronic data. Under consideration now is a proposal to develop four GIS centers on campus that will be coordinated by an administrative group of faculty.

Third, the library has played a critical role in the group. Not only does librarian Vivienne Roumani chair the group, but she often functions as a neutral filter for the ideas of group members.

Finally, the group is a true task force, with a clear, limited charge and the ability to solve many problems on the spot. Now that it has achieved much of its charge, the group is considering transforming itself into the UCB Data Repository Committee, which will more clearly reflect the vision that has evolved.

Contact: Vivienne Roumani-Denn
Phone: (510) 643-7041
Email: <vroumani@library.berkeley.edu>
Website: <http://www.lib.berkeley/UCBGIS>

North Carolina State Focuses on Data, Training, and Upgrading Staff Skills

Like many libraries with recently developed GIS-based services, the North Carolina State University Libraries were compelled to solve the problems presented by the availability of 1990 U.S. Census data in machine-readable form and the unavailability of easy-to-use software for data access and manipulation.

NCSU Libraries started its service with help from the 1992 ARL GIS Literacy Project, which provided initial software and data, courtesy of ESRI and Wessex. NC State organized this start-up effort by forming a small team consisting of librarians and a computer center staff member in liaison with a faculty member in a GIS leadership role on campus (details of the organization can be found in *The Journal of Academic Librarianship*, July 1995). The team developed a vision statement and began planning for GIS services. Though they have retained the successful team structure, the role of the library has been more clearly defined during the last five years: the focus is on data collection and management.

One challenge faced the start-up effort: as library professionals, key team members had little expertise in GIS. As expertise was acquired, these librarians began to offer sessions in basic GIS skills for other staff so that they would have an understanding of the scope of desktop mapping software and be able to provide assistance to users. Also, in the spring of 1993, the GIS team developed and taught an introductory class, "ArcView Basics: GIS for the Fun of It," which was offered to NCSU faculty, staff, and students.

Currently, an instructional team is developing an online tutorial

on the Web, the GIS Tutor Project. This approach mirrors (and is a by-product of) a movement toward a distance learning approach in instructing NCSU's students: more and more of the course-based instruction related to GIS is being conducted online and fewer classroom contact hours are being required. When completed, the GIS Tutor will enable any library user or staff member to move through an introductory tutorial on GIS and begin creating thematic maps. The tutorial will include exercises that utilize North Carolina geographic and census data.

During 1994-96, the library was also a partner in the development of an SDIRE (Student-Directed Information-Rich Education) Project funded by a special campus grant. This project, which focused on GIS along with other subjects, demonstrated ways to integrate library resources into the educational process.

Recently, in a move to bring more focused GIS and data management expertise into the libraries, the position of Librarian for Spatial and Numeric Data Services has been advertised. The person hired in this position will have responsibility for the "development and management of GIS and other spatial and numeric data resources and services supporting all areas of the university" and will be required to maintain "a high level of awareness and expertise regarding spatial and numeric data and its evolving applications." Experience with spatial and numeric data resources is required, as well as "demonstrated proficiency with both GIS and social sciences statistical software applications." This position announcement will be available on the *Transforming Libraries* Website.

Contact: Carolyn Argentati
Phone: (919) 515-2306
Email: <Carolyn_Argentati@ncsu.edu>
Contact: Lisa Abbott
Phone: (919) 515-2936
Email: <Lisa_Abbott@ncsu.edu>
Website: <http://www.lib.ncsu.edu/stacks/gis>

GIS-based services at three Canadian ARL libraries

Canadian ARL libraries offering GIS-based services face challenges in the acquisition of data that are largely unknown to their U.S. colleagues. While U.S. libraries typically moved into GIS because they were overwhelmed with free machine-readable data from the federal government, all Canadian government data are copyrighted and libraries must pay for it. Recently, through the Data Liberation Initiative introduced by Statistics Canada, access to census data is loosening up a bit, and a few government agencies are understanding that arrangements such as barter partnerships with libraries can

be mutually beneficial. On the whole, however, libraries still face steep charges for electronic government data. Interviewed Canadian librarians acknowledged that this situation has kept them from developing the sorts of GIS-based services that many U.S. libraries have. Nonetheless, three libraries in Ontario have managed to develop innovative services.

McMaster University and ECOWISE

ECOWISE is a large interdisciplinary grant-funded project focusing on Hamilton Harbor. With the grant funding came a mandate to make resulting data available both to the funding agency and to the general public. Libraries were seen as the natural conduit to the public. McMaster University Library has been able to mount ECOWISE data on its cartographic workstation, and plans are in the works to make some of the data available on the Web. ECOWISE has also donated digital topographic data it purchased from the Ontario government to the library, and though use of the data is tightly licensed, all educational uses are permitted.

McMaster librarian Cathy Moulder has been compiling a bibliography on GIS and libraries which she regularly updates.

Contact: Cathy Moulder
Phone: (905) 525-9140 ex. 24745
Email: <moulder@mcmaster.ca>
Website:
<http://informer1.cis.mcmaster.ca/library/campus/maps/gis&libr.htm>

University of Toronto and Project TRAIL

When the University of Toronto's Digital Map Users Group wanted to develop a program to teach GIS and data analysis skills, they developed the Teaching and Research Atlas for Integrated Learning (TRAIL) Project. They also turned to the library to play an important role.

TRAIL will work at the interface level, permitting instructors to go into a database of geo-referenced data, find the data they need, and be alerted to restrictions on use. Most importantly, they return courseware they develop, along with value-added data to be used to pay for large amounts of Ontario Government data, for example. TRAIL will also enable students to window certain instructional exercises

through the system once they have learned GIS basics.

Another project that grew out of the users group is the Greater Toronto Atlas. Currently they are at the stage of starting to acquire some of the data for this project; some of the data will require further expenditure of funds for conversion and cleanup.

The library is the archives for the data associated with TRAIL and the Atlas. Thus librarian Joan Winearls sees her role not as a GIS expert, but as a builder and manager of the database; developing agreements with data providers and managing licenses are just part of the job. In addition, says Professor Robert M. Wright, of the Program in Landscape Architecture, the library acts as a catalyst, bringing experts and users together, creating an expanding, common resource for teachers and researchers.

Winearls sees the need to develop a friendly front-end interface for the system they are developing. To do this, they are hoping to bring a technical person on board.

Contact: Joan Winearls
Phone: (416) 978-1958
Email: <winearls@vax.library.utoronto.ca>
Contact: Robert M. Wright
Phone: (416) 978-6788
Email: <wright@clr.utoronto.ca>

Securing Data at Waterloo

In spite of the challenges of acquiring Canadian data, the University of Waterloo has put three gigabytes of data on a UNIX server owned by the library and made one machine available for GIS service. To get to the data, users must ask staff for help. Each staff member has access to a diskette with a small batch file that opens access to the UNIX server; when the requested data have been copied, the diskette is used to return the workstation to a secure, non-networked Windows environment.

Such measures are useful for several reasons. Staff are thus able to authenticate user identity and make sure that only authorized educational users are gaining access to the data. Moreover, their GIS service approach is to mediate searches; for all but the most sophisticated user, help is available in determining that the data accessed will be truly useful.

Plans are underway to provide access to geospatial data through anonymous FTP; users will email or otherwise communicate with the library to indicate their interest in a particular data

file or set of files. Once library staff have authenticated these users, the data will be made available on a time-limited basis for anonymous FTP.

Richard Pinnell is currently negotiating with the local county authority to acquire street network data and cadastral data for use by students at the university. The county authority, as well as several other government and commercial suppliers of geospatial data, require that the library limit access to authorized members of the university community and, in some cases, request that the library track the subsequent uses of these data. In order to comply with these license provisions, the library has compiled a data release form (see the *Transforming Libraries* Website); for ethical reasons, however, the library will not provide vendors with personalized use information.

Contact: Richard Pinnell
Phone: (519) 888-4567 ext 3412
Email: <rhpinnel@library.uwaterloo.ca>
Website:
<http://www.lib.uwaterloo.ca/discipline/Cartography/umd.html>

Three non-ARL libraries offer diverse examples of GIS-based services

Montana State Library Moves Ahead on Several Fronts

The Natural Resource Information System (NRIS), part of the Montana State Library, is one of the most comprehensive and active GIS operations in the country, providing resources both on-site and over the Internet. Of the approximately 25 NRIS staff, six are GIS professionals; none of the staff are librarians.

NRIS has been putting geo-referenced databases, with full documentation, on the Internet for several years. Though most of the data focuses on natural resources in the state of Montana, they provide access to other data as well. In choosing data to mount, selectors employ a simple criterion: the popularity of the particular dataset as measured by requests that they have received for access to it. In part, this policy derives from the need of staff to provide non-mediated access to data so that they can be free for other activities.

An important aspect of mounting data at NRIS has been the early decision to maintain compliance with standards established by the Federal Geographic Data Committee. These standards govern the creation of documentation (metadata or "cataloging data"), discovery (how someone will find the data on the Internet), and

dissemination (especially through the several nodes that are being established by the National Spatial Data Infrastructure, or NSDI). As an NSDI node, NRIS is participating in a forward-looking national program that enables data searchers to locate repositories on a number of nodes that are linked.

On-site, NRIS provides two levels of GIS-based service:

- Access to data. This is considered the core service and is provided free to all but users from the private sector, who pay an hourly fee for staff time involved in searching and providing data (the charge is not for the data, of course, which is in the public domain). Private users are defined as, "any business, entity, or individual using, directly or indirectly, the data and services as part of a potential for-profit activity."
- GIS Bureau. Contract services are provided here, almost exclusively to government agencies. Services include programming, database design, spatial analysis, cartographic design, and database development. Staff are careful to refer non-agency users to private GIS service providers.

As a non-profit agency, NRIS tries to choose contract work that will have a larger benefit; such benefits include the generation of further data for mounting on their node or an opportunity to coordinate GIS activities of larger groups. Coordination of GIS projects and activities is, in fact, another core task for NRIS. One such group whose activities are coordinated by NRIS is the Montana Interagency GIS Technical Working Group, composed of 22 federal and state agencies that have pledged to cooperate on GIS projects—most especially to share data.

NRIS has an active educational program, providing sessions both on- and off-site in Montana. One target audience is K–12 teachers. Currently, they are developing a workbook to be used in teaching GIS, and this will be shareable at a future date with the GIS community.

The next major step for NRIS is to shift the focus somewhat away from data provision to information services. Thus they are exploring ways of mounting data so that users do not need to be expert in either data management or GIS to get the information they are seeking.

Contact: Fred Gifford
Phone: (406) 444-5357
Email: <fred@nris.mt.gov>
Website: <http://www.nris.mt.gov>

New York State Library Helps Various Agencies

The New York State Library's Research Division demonstrates how GIS-based services can be offered effectively by trained generalists with a little help from technical experts. Terry Strasser, the library's GIS expert, is neither a documents nor a map librarian, and yet she has developed true value-added services for the library's clientele. Recently, she helped the New York State Police develop maps showing troop boundaries, and the State Racing and Wagering Board found her assistance invaluable in their site study.

An important first planning assumption for the NYSL was that GIS services would be fully integrated into their reference services. And though their current service is almost completely mediated by Terry and two other staff who back her up, they will soon establish a public workstation in the library's reference area.

This workstation will feature the Newspaper Locator Project, which was developed jointly with the federally funded New York State Newspaper Project. The NLP will be a gateway to the vast collection of New York newspapers held by the NYSL on microfilm. Users will be able to search the system both geographically and verbally using sophisticated Boolean operators—a boon to local historians and genealogists as it will enable searches spanning political boundaries.

Development of the NLP was facilitated by a technical consultant, who stripped functionality from the ArcView GIS system so that a first-time client could use it effectively without mediation. The NLP is a good example of what Strasser calls a "kiosk application," a system that most users can access without help from library staff.

Two more projects of this sort are in the works. In partnership with the State Emergency Management Office, they will provide electronic mapping of historical earthquake sites in New York. And with the New York State Office of Parks, Recreation and Historic Preservation, they will provide point-and-click mapping of parks and boat launching sites around the state. The latter will even provide information on how many parking spaces are at each facility.

The library is also using GIS more and more as an in-house tool. One project portrayed reference queries by zip code throughout the state, enabling the library to demonstrate that they were serving the whole state of New York, not just the Albany region. They have also assisted the State Library's Division of Library

Development in mapping the 760 chartered public libraries around the state that constitute one segment of their service population, a capability that can now be used for many purposes.

Contact: Terry Strasser
Phone: (518) 474-5959
Email: <tstrass@unix2.nysed.gov>
Website: <http://www.nysl.nysed.gov/gis.htm#c>

Saint Louis Public Library Brings GIS to the People

In partnership with a faculty member at Southern Illinois University at Edwardsville, Ann Watts of the Saint Louis Public Library developed a project to address the fact that the federally developed Urban Atlas, the electronic atlas of St. Louis City and County, had not been updated since 1970. The atlas is mounted on a workstation in the library's public service area.

Though we tend to think of GIS as a tool that requires a certain level of technical skill, it can be customized for use by virtually anyone. To accommodate the needs of the general public even further, they customized the ArcView software available on the machine: this design is capable of handling many questions brought to the library. More complex questions are referred to Illinois and Missouri data centers in the region that have full GIS installations. Conversely, the data centers refer some first-time users to the public library.

Much use of this GIS tool is by people who are doing grant applications. The system provides maps—for example, of at-risk youth populations in certain areas—that help support the applications. Another frequent user group is nursing students doing assignments in public health courses. The tools available on the workstation are regarded by reference staff as another tool for responding to user needs.

Though there has been no time for further development of this public access GIS tool, Watts feels that the new census will push the library toward further development.

Contact: Ann Watts
Phone: (314) 539-0377
Email: <awatts@slpl.lib.mo.us>

Three report sites defy easy categorization

All three reports foretell much about where GIS is going in the future. One is the vendor ESRI; the other two are sites of research projects. The editor was fortunate to be able to interview on-site at ESRI in

Redlands, California, and at Project Alexandria on the UC Santa Barbara campus.

University of Southern California: ISLA Becomes IDA

Hearing about the inner workings of the ISLA/IDA Project at the University of Southern California, one is reminded of standard archival practice. Cataloging is done at the collection level, with records produced for individual items as well. All work is done with rigorous attention to standards. Here the similarities end, however, as this is a digital library of multi-disciplinary materials in multiple formats organized for access by spatial, temporal, textual, and format indices.

At the heart of the project is USC's estimable archives of Los Angeles—the universal availability of these archives alone would make the project worthwhile—but the Project goes much further than this. Li Hunt reports that the Information System for Los Angeles (ISLA) has now become the Integrated Data Archives (IDA). Originally intended to focus on the Los Angeles area, the project now rolls all of USC's digital library projects into one. Though IDA is actually a huge database made up of a number of databases, this organization will be transparent to the end user. Particularly exciting to IDA developers is the Coordinate Index which will enable users to work with either point or area data.

Readers are encouraged to visit the project's Website where further wonders await. Particularly impressive is the capability of layering geo-data in time—even to begin with an historical perspective. Such a search might begin with the depiction of a local site as it appeared in 1939 and show its development in stages up to the present.

IDA is still experimental at this point. The next step is for USC to bring their system up on the Web, an event that could happen as early as summer 1997. Later, other locations will have access to system software that is currently being developed in JAVA. The intention is eventually to give this software away (on analogy with Netscape software) in return for data and images that partner locations will contribute to IDA by mounting them locally for system access. Building the links between these platform-independent locations is a challenge that the project is just beginning to work on.

In the meantime, NEH funding is enabling USC to make the project available to the Los Angeles school system in 1998.

Because the system will require a basic technical capability, teachers will be trained in special workshops.

Amid all the dazzling technical achievements of the IDA Project, it is tempting to pass over significant behind-the-scenes achievements. These include an active, truly synergistic partnership between the library and the faculty, with both supplying vision and creativity, as well as day-to-day problem solving. As an example, item level processing time has been improved through careful attention to process improvement; staff are closing in on a goal of not more than five minutes per item.

Contact: Leta "Li" Hunt
Phone: (213) 740-8496
Email: <lihunt@calvin.usc.edu>
Website: <http://www.usc.edu/Library/ISLA>

UC San Diego Partners with Local Government Association

Among the benefits of this assignment were two field trips I was able to make in Southern California. These were prefaced by a visit to UC San Diego's Geisel Library, where Mark Waggoner and Larry Cruse generously gave me my first live introduction to GIS in a lab setting.

UCSD's installation is worth a moment's description as it is a good example of a lively, busy service that does not support a geography department. The library's data services lab provides dedicated GIS terminals and periodic instruction for the growing number of students who use GIS-based inquiry as part of their coursework. Most of these students are in the social sciences: sociology, anthropology, and urban studies and planning, but use comes from all areas. Though most available data are acquired from the federal government, UCSD has been able to tap the San Diego Association of Governments for City of San Diego data, and other partnerships have been developed as well. Most recently, staff have taken the show on the road, appearing at schools in the area and demonstrating GIS capabilities.

Contact: Mark Waggoner
Phone: (619) 534-1249
Email: <mwaggoner@ucsd.edu>
Contact: Larry Cruse
Phone: (619) 534-1248
Email: <lcruse@ucsd.edu>

A Visit to Redlands: ESRI

Redlands, California is itself a gem waiting to be discovered, with a town center featuring a charming, ramshackle public library built in a converted church and a small open-air amphitheater for cultural and civic events. The GIS world, however, knows Redlands as the corporate headquarters of ESRI (the Environmental Systems Research Institute, Inc.), a provider of GIS application software.

Michael Phoenix of the Marketing Division of ESRI provided an up-close introduction to their ArcView system and provided generous insight into the world of GIS and the mission of ESRI. Subsequent phone conversations with Angela Lee of ESRI's Minneapolis office also contributed significantly to this account.

ESRI is developing new products that are indicative of impending changes in the world of GIS. (ARL does not endorse vendors or their products; the following descriptions are simply meant to illustrate trends.)

The hot news at ESRI is the development of two new Internet access products: the ArcView Internet Map Server and the Map Objects Internet Map Server. The first product will provide interaction with ArcView as it runs on someone else's Website, enabling users to take advantage of ArcView's functionality on a remote machine. The Map Objects Internet Map Server does the same thing, but the difference is that it requires you to build your own mapping engine which will allow users access to your spatial data over the Internet using any standard browser, such as Netscape. Though the first product is easier to install and get running, the advantages of the second are speed, the ability to handle multiple requests efficiently, and the capability of customizing interfaces to accommodate the diverse skill levels of local users.

The second notable product under development is ArcVoyager, which started with a Fulton County School District (Georgia) request that ArcView be customized for student use. ArcVoyager is essentially a set of geo-referenced data and a shell that operates over ArcView and coaches the user through data search, analysis, and display procedures. The implications for GIS and spatial literacy education are clear in such a product. Though intended to supplement ESRI's considerable investment in K–12 education, a product like ArcVoyager is likely to have uses in college level instruction as well.

While it is easy to be entranced by the technical capabilities of GIS, Mike Phoenix stresses that the company is more interested in promoting effective problem solving through application of skilled

geo-spatial thinking. In beginning to design a new ArcView textbook, therefore, Phoenix will begin with fundamentals of problem solving and data analysis, then move to GIS as a specific tool. Ultimately, the vision is to bring such problem-solving capability to all communities, and ESRI sees the library as a key player in gathering and managing data.

Contact: Michael Phoenix
Phone: (909) 793-2853
Email: <mphoenix@esri.com>
Contact: Angela Lee
Phone: (612) 454-0600
Email: <alee@esri.com>
Website: <http://www.esri.com>

The Alexandria Digital Library Project at UC Santa Barbara

Much has been written about the NSF-funded Alexandria Digital Library Project, and its Webpage is a treasure trove of information. In brief, the ADL proposes to be "a distributed digital library of geographically-referenced information." At the core of the project is the mounting in electronic form of the considerable resources of UCSB's Map and Imagery Library. Now in beta test, the system should be available for Web access in June 1997. Specifically available in June will be will be an Alexandria Catalog of approximately one million records (consisting mostly of records for maps and aerial photographs) and the Alexandria Gazetteer, containing six million place names covering the globe (including undersea locations). Later, actual image, map and text datasets will be available through the Alexandria Website.

With such a huge database, it is no wonder that a major purpose of the project is to test database management software. According to Mary Larsgaard, they are currently testing three software packages. Also being worked on are content analysis tools, such as the use of text phrases for searching image content, to help researchers more effectively find what they are looking for. One goal in Alexandria's future is to provide users with a limited number of software tools for manipulating spatial data in digital form.

Like many library staff steeped in GIS technology, Larry Carver and Mary Larsgaard stress that digital tools must be regarded as another means of providing users with answers to their reference questions—that the technology should be used when appropriate to the client's needs and data-format constraints.

Eventually, Alexandria will be a true distributed digital

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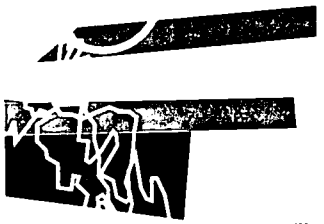
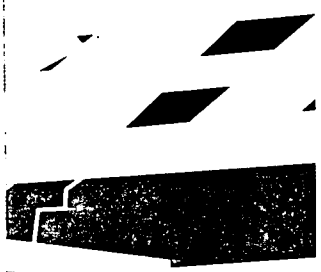
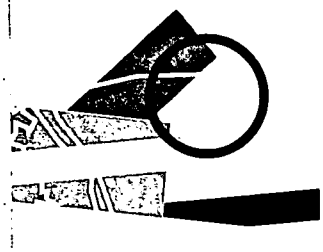
library—a federation of locations of geo-referenced information that can be accessed through a single interface, providing libraries all over the world with opportunities to share their geo-referenced information with Internet users.

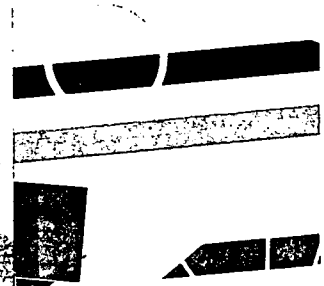
Contact: Larry Carver
Phone: (805) 893-4049
Email: <carver@sdc.ucsb.edu>
Contact: Mary Larsgaard
Phone: (805) 893-4049
Email: <mary@sdc.ucsb.edu>
Website: <http://alexandria.sdc.ucsb.edu>

GIS: The Future



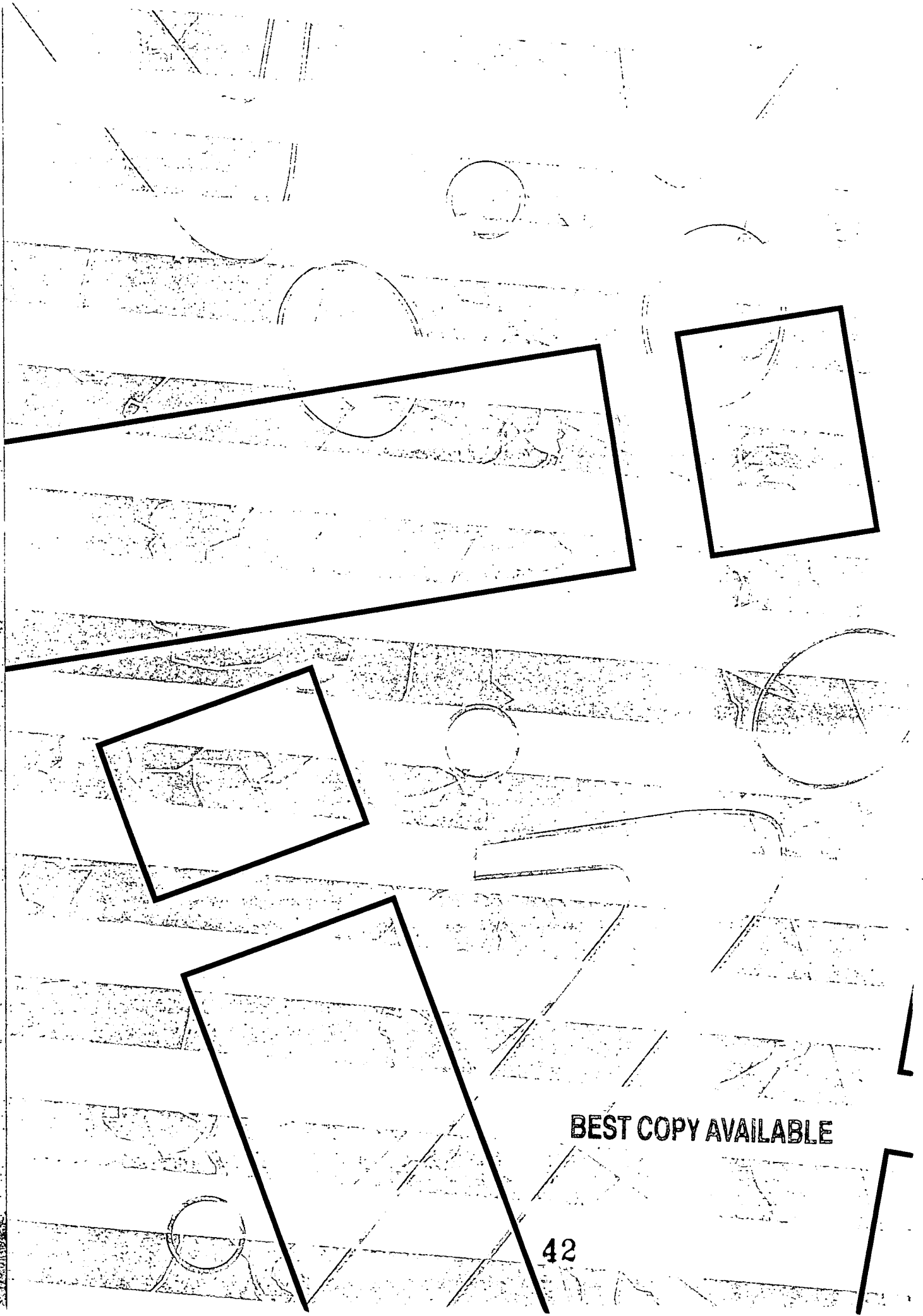


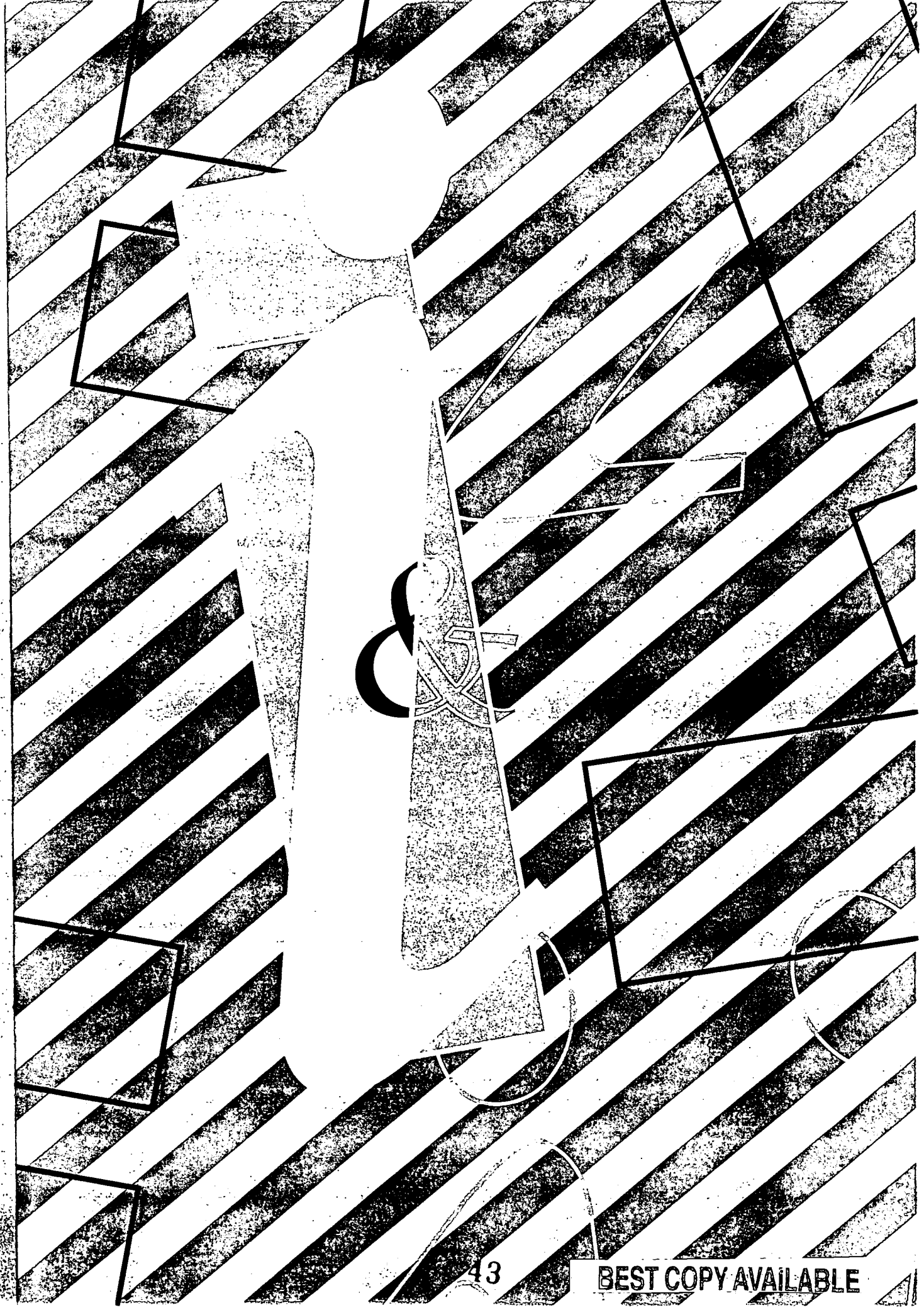




IN a real sense, the future of GIS is in the reports from the field. Some trends might be useful to summarize here, however:

- GIS will only grow and become an increasing part of our information consciousness. Our users will become more familiar and skilled with the technology, and they will become more data- and spatial-literate.
- Standards of all sorts will become increasingly important, especially standards for metadata (the description of GIS and other data).
- Storage will become less of a problem as space becomes cheaper and compression techniques become more widely used. One factor may be the possibility of a pervasive ability to create one's own CD-ROMs.
- GIS will begin to appear in standard packages, such as spreadsheets, and GIS software itself will probably evolve into off-the-shelf products that virtually anyone will be able to master.
- Internet GIS capabilities will grow tremendously—not only the ability to access static information, but also the ability to interact with and manipulate the data online.
- Distributed collections will be aggregated under projects like Alexandria and USC's Integrated Data Archive. Such projects will make enormous amounts of geo-referenced information available over the Internet.
- Librarians will take more managerial roles in the design and provision of GIS services, leaving the technical aspects to specially trained technicians.





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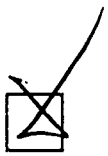

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